Solar Chemicals and Materials Part II

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Overview

- Main work performed on

  - Limestone (see Dr. Meiers presentation)
    - New projects are expected in EU HORIZON 2020 as industrial processes is a special topic
    - SOLPART will start January 1st, 2016

  - Sulfuric acid
    - Ongoing projects like the FCH-JU SOL2HY2, a further development is expected as well

  - Aluminum
    - South African – German project SOLAM
Solar Aluminium Recycling –
Work performed in a National German Project

- Partner was VAW, now HYDRO
- Development of a rotary kiln
  - Batch reactor to be operated in DLR’s solar furnace
  - Kiln made from SiSiC to be able to handle different materials
  - Up to 10 kW$_{th}$ heat input
  - Up to 3 kg of UBC (Used Beverage Cans)
- Development of strategies for solar aluminium scrap (UBC) recycling
- Control of the materials quality
  - Solar Aluminium is about 0.2% “cleaner“ than industrial recycled aluminium
- Technology is able to deal with even more difficult scrap like Mg
DLR‘s Solar Furnace

- Off-axis design
- 160 hexagonal facettes
- Concentration factor up to 5500 = 5 MW/m²
- 25 kWₜₗ maximum power
- Up to 2700°C
- In operation since 1994
- Over 200 experiments since then
Rotary Kiln Development
Recycling of UBC
Present Status

- Design of a new rotary kiln for continuous feeding
- Tests since summer 2013
- More test results will be reported in the forthcoming conferences
- Since 2015 South-African German bilateral project SOLAM
Rotary kiln: concept
Final reactor
Experiments

I₀ = incident power
RESULTS

A maximum cavity temperature of 1000°C could be obtained in less than 3 hours with a maximum temperature difference $\Delta T_{\text{max}} = 80°C$

The hottest point on the lateral wall is at 20cm from the cylinder aperture.

The coldest points, except the gas outlet pipe (TC9), are the peripheral (both front and back).

After 2.4h, all the lateral wall is hotter than 900°C.
After 4h, the whole lateral wall is hotter than 950°C, the central part is at 1000°C.

The longer the cavity is heated, the more uniform the temperature becomes: after 5.2h, $\Delta T_{\text{max}} = 50 K$
SOLAM - Solar Aluminium Melting in a directly heated Rotary Kiln

aluminium / aluminium waste

CLIENT 3 – International Partnership for Environmental Technologies
South African – German bilateral Project
CSIR, ESKOM, NFTN, DST, NWU, DLR, AixProcess
SOL2HY2 – Open TCC

- FCH JU project on the solar driven utilization of waste SO₂ from fossil sources for co-production of hydrogen and sulphuric acid

- Hybridization by usage of renewable energy for electrolysis

- Partners: EngineSoft (IT), Aalto University (FI), DLR (DE), ENEA (IT), Outotec (FI), Erbicol (CH), Oy Woikoski (FI)

- > 100 kW demonstration plant on the solar tower in Jülich, Germany
Investments vs. revenues

- Reduction of initial investments
- Financing of HyS development by payback of OOC
- Increase of total revenues
Design of SOL2HY2 pilot plant

Solar receiver

Adiabatic catalyst reactor

SO$_2$, O$_2$, SO$_3$, H$_2$O (g)
750 °C

SO$_3$, H$_2$O (g)
400 °C

Gas analysis

Electrical evaporator

~100 kW total thermal power on research platform of Solar Tower Juelich

H$_2$SO$_4$(aq)
1 l/min (50 w%)

Minister Remmel visits Sol2Hy2
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Thank you very much for your attention!